REMARKS

This is a full and timely response to the outstanding FINAL Office Action mailed September 20, 2007. The Examiner is thanked for the thorough examination of the present application. Upon entry of this response, claims 1, 3-10, 12-23, 25, and 26 are pending in the present application. Claims 1, 4, 5, 7-9, 13-15, 17, 19-21, 23, 25, and 26 are rejected under 35 U.S.C. §102(e) as allegedly being anticipated by *Voorhies et al.* (U.S. Pat. No. 7,023,437, hereinafter "*Voorhies*"). Claims 3, 6, 10, and 18 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Voorhies* in view of *Gannett* (U.S. Pat. No. 6,118,452). Claims 12, 16, and 22 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Voorhies* in view of *Griffin* (U.S. Pat. No. 5,990,904). Applicants respectfully request consideration of the following remarks contained herein.

I. Examiner Interview

Applicants first wish to express their sincere appreciation for the time that Examiner Hsu spent with Applicants' representatives (Jeffrey Hsu and Daniel R. McClure) during a telephone discussion on October 30, 2007 regarding the outstanding FINAL Office Action. In that discussion, Examiner Hsu and Applicants' representatives discussed the arguments put forth by Examiner Hsu in the **Response to Arguments** section, and certain distinctive features of the claimed embodiments of the present application. Examiner Hsu indicated that the rejection embodied a very broad reading of the claim language, and that further clarifying features (like the compressed z-buffer) would more clearly define over cited art.

The amendments presented herein are consistent with the suggestions and overall discussion with Examiner Hsu, and Applicant submits that the amendments made herein should be allowed over the applied art for at least the reasons discussed in the telephone interview. Accordingly, Applicants respectfully request the Examiner to consider the present response and the remarks and amendments contained herein.

II. Response to Claim Rejections Under 35 U.S.C. § 102

Claims 1, 4, 5, 7-9, 13-15, 17, 19-21, 23, 25, and 26 remain rejected under 35 U.S.C. §102(e) as allegedly being anticipated by *Voorhies*. For at least the reasons set forth below, Applicants traverse these rejections.

Independent Claim 1

Independent claim 1, as amended, recites (emphasis added):

> 1. A multi-pass method of rendering a plurality of graphic primitives comprising:
> in a first pass:
> passing only a limited portion of graphic data for each primitive through a graphic pipeline, wherein the limited portion of graphic data comprises location-related data;
> processing the limited portion of graphic data to build a compressed z-buffer, the compressed z-buffer comprising a plurality of z-records, ***each z-record embodying z information for a plurality of pixels such that condensed depth information for the plurality of pixels is represented by a single z-record***;
> setting a visibility indicator, for each primitive, if any pixel of the primitive is determined to be visible;
> in a second pass:
> for each primitive, determining whether the associated visibility indicator for that primitive is set;
> discarding, without passing through the graphic pipeline, the primitives for which the associated visibility indicator is not set;
> passing the remaining portion of graphic data for each primitive determined to have the associated visibility indictor set;

> ***performing a two-level z-test on graphic data, wherein a first level of the z-test compares the graphic data of a current primitive with corresponding information in the compressed z-buffer, and wherein a second level of the z-test is performed on a per-pixel basis in a z-test manner, wherein the second level z-test is performed only on pixels within a record of the compressed z-information in which the first level z-test determines that some but not all pixels of an associated macropixel are visible***; and
>
> communicating data associated with pixels of macropixels determined to be visible to a pixel shader for rendering.

Applicants respectfully maintain that independent claim 1 patently defines over *Voorhies* for at least the reason that *Voorhies* fails to disclose, teach or suggest certain features in claim 1.

A. Voorhies Fails to Disclose the Compressed Z-Buffer Defined in Claim 1

In the **Response to Arguments** section, the Office Action indicates that the Applicants' arguments were not persuasive. (Office Action, page 2). In particular, the Examiner continues to assert that *Voorhies* discloses a compressed z-buffer. ("*Voorhies teaches z-pyramid data structure is hierarchical z-buffer that is compressed (c. 33, ll. 36-39; c. 55, ll. 66-67), and so is considered to be equivalent to compressed z-buffer*.") Applicants, however, respectfully disagree and maintain that while *Voorhies* teaches of a z-pyramid data structure that is hierarchal in nature, *Voorhies* does not appear to teach that the z-pyramid is compressed where each z-record within the compressed z-buffer embodies z information for a plurality of pixels. The Examiner alleges that *Voorhies* teaches of a "compressed z-buffer" in the following text:

> With respect to the second portion 3908, the data structure 3900 may include color information 3912, texture coordinates 3914, and/or color-related state information 3910. Either portion of the data structure 3900 of graphics data may be compressed in a loss-less or lossy manner.

(Col. 55, lines 63-67). Applicants respectfully submit that the text passage above relates to portions of a <u>data structure 3900</u>, namely position information, position-related state information, and/or optional bounding box information, color information, texture coordinates, and/or color-related state information and not to a "compressed z-buffer." This data structure 3900 is stored in the memory 3810 (shown in FIG. 38) for use during multiple-pass rendering. ("This is accomplished by storing <u>graphics data</u> from the geometry module 3802 <u>in a particular data structure</u> in the memory 3810 for being accessed during multiple-pass rendering." col. 55, lines 11-14) Furthermore, while *Voorhies* teaches of a hierarchical z-pyramid, this is not equivalent to a compressed z-buffer. As such, Applicants respectfully maintain that *Voorhies* fails to disclose a "compressed z-buffer."

Assuming, *arguendo*, that *Voorhies* does disclose a compressed z-buffer, as alleged by the Office Action, *Voorhies* still fails to teach the limitation "each z-record embodying z information for a plurality of pixels." At most, the text passages cited by the Office Action (col. 54, lines 44-55; col. 6, lines 1-14) teach that "tiles that are culled during processing with the coarse rasterizer 3792 <u>may be skipped</u> during processing" and "hierarchical z-buffering is more efficient." However, the Office Action fails to indicate how *Voorhies* teaches of each z-buffer comprising multiple z-records where each z-record embodies z information for a plurality of pixels. Claim 1 now further recites, "such that condensed depth information for the plurality of pixels is represented by a single z-record."

Applicants submit that the section "Encoding of Depth Values" within the *Voorhies* reference beginning at col. 28, line 61 appears to be more relevant to the

discussion regarding compressed z-buffers. Here, *Voorhies* teaches that "[s]torage requirements of the z-pyramid 170 can be reduced by storing depth information for tiles in a more compact form than NxN arrays of z-values." (Col. 28, lines 62-64). *Voorhies* further teaches that "[p]referably, offsets are stored at relatively low precision (e.g., in 4 bits each) and znear is stored at higher precision (e.g., in 12 bits)." (Col. 30, line 67 to Col. 31, line 2). However, Applicants submit that storing offsets at relatively low precision is not equivalent to the compressed z-buffer claimed above, which includes the limitation, "each z-record embodying z information for a plurality of pixels such that condensed depth information for the plurality of pixels is represented by a single z-record." Applicants respectfully submit that *Voorhies* fails to teach of a compressed z-buffer that comprises z-records where each z-record represents condensed depth information for a plurality of pixels.

B. Voorhies Fails to Disclose a Two-Level Z-Test as Defined in Claim 1

As Applicants asserted in the prior Office Action Response, *Voorhies* fails to teach performing a two-level z-test on graphic data as recited in claim 1, wherein:

> *a first level* of the z-test compares the graphic data of a current primitive with
> corresponding information in the compressed z-buffer, and
> *a second level* of the z-test is performed on a per-pixel basis in a z-test manner,
> where the second level z-test is performed only on pixels within a record of the compressed z-information in which the first level z-test determines that some but not all pixels of an associated macropixel are visible.

In the **Response to Arguments** section, the Examiner states the following: "*Fig. 11 in Voorhies shows flowchart of z-test, and shows z-test (1114) is first*

performed on one level, and if that level is not the finest level (1118), the z-test process <u>*loops back to the beginning and repeats*</u> *the z-testing process for the next finest level . . .*" (Office Action, page 2). Applicants agree, and in fact argued in the prior response that *Voorhies* teaches that "[t]he algorithm performs z-buffer tiling hierarchically on NxN regions of image space using a z-pyramid having NxN decimation <u>from level to level to store the depths of previously rendered polygons</u>." (Col. 6, lines 4-8). The "levels" disclosed in the *Voorhies* reference relate to different levels in a z-pyramid. *Voorhies* further teaches that "[s]ince a z-pyramid has <u>a plurality of levels which are each a depth buffer</u>, it can also be described as a hierarchical depth buffer." (Col. 8, lines 56-58).

However, Applicants respectfully point out that claim 1 explicitly defines a first level z-test and a second z-test (and the interrelationship between the two tests). *Voorhies* fails to teach this. In fact, the Examiner states that "the z-test process <u>loops back to the beginning and repeats</u> the z-testing process for the next finest level." That is, the same z-test appears to be performed in an iterative fashion. There is no distinction made between the first level z-test and the second level z-test, as clearly defined in claim 1. In this regard, *Voorhies* fails to disclose, teach, or suggest performing the two-level z-test on graphic data as recited in claim 1 above.

In view of the foregoing, Applicants respectfully submit that independent claim 1 patently defines over *Voorhies* for at least the reason that *Voorhies* fails to disclose, teach or suggest the highlighted features in claim 1 above.

Dependent Claims 3-7

Applicants submit that dependent claims 3-7 are allowable for at least the reason that these claims depend from an allowable independent claim. *See, e.g., In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988).

Independent Claim 8

Claim 8, as amended, recites (emphasis added):

> 8. A method of rendering a plurality of graphic primitives comprising:
>
> passing, within a graphic pipeline, only a limited portion of the graphic data associated with each primitive, wherein the limited portion of graphic data comprises location-related data; and wherein each primitive comprises a plurality of pixels;
>
> processing the limited portion of graphic data associated with each individual primitive to build a compressed z-buffer for each primitive, ***wherein each compressed z-buffer contains a plurality of z-records which each contain compressed z-information for a macro-pixel***;
>
> determining, for each primitive, whether the primitive has at least one visible pixel;
>
> communicating data associated with pixels of primitives determined to have at least one visible primitive to a pixel shader for rendering; and
>
> passing and processing, within the pixel shader, the remaining graphic data associated with each primitive only for those primitives determined to have at least one visible pixel, wherein the remaining graphic data includes at least one of the following: lighting, texture, and fog data.

The Office Action cites substantially the same text passages cited in the rejection of claim 1 to reject claim 8. Applicants have further amended claim 8 to more clearly define the compressed z-buffer. Claim 8 now recites the limitation, "wherein each compressed z-buffer contains a plurality of z-records which each contain compressed z-information for a macro-pixel." At most, the text passages cited by the Office Action

(col. 54, lines 44-55; col. 6, lines 1-14) teach that "tiles that are culled during processing with the coarse rasterizer 3792 may be skipped during processing" and "hierarchical z-buffering is more efficient." However, nowhere does *Voorhies* disclose that each compressed z-buffer contains a plurality of z-records which each contain compressed z-information for a macro-pixel. *Voorhies* discloses both a "tiling record" and a "rendering record," where the rendering record is output to the z-buffer renderer. *Voorhies* teaches that "[s]torage requirements of the z-pyramid 170 can be reduced by storing depth information for tiles in a more compact form than NxN arrays of z-values." (Col. 28, lines 62-64). *Voorhies* further teaches that "[p]referably, offsets are stored at relatively low precision (e.g., in 4 bits each) and znear is stored at higher precision (e.g., in 12 bits)." (Col. 30, line 67 to Col. 31, line 2). However, Applicants submit that storing offsets at relatively low precision is not equivalent to the compressed z-buffer claimed, which includes the limitation highlighted above.

Accordingly, Applicants respectfully submit that independent claim 8 patently defines over *Voorhies* for at least the reason that *Voorhies* fails to disclose, teach or suggest the highlighted features in claim 8 above.

Dependent Claims 9, 10, and 12

Applicants submit that dependent claims 9, 10, and 12 are allowable for at least the reason that these claims depend from an allowable independent claim. *See, e.g., In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988).

Independent Claim 13

Claim 13, as amended, recites (emphasis added):

> 13. A method of rendering a plurality of graphic primitives comprising:
>
> passing in a first pass, within a graphic pipeline, only a limited portion of graphic data for each primitive, wherein each primitive comprises a plurality of pixels and wherein the limited portion of graphic data comprises location-related data;
>
> processing the limited portion of graphic data to build a compressed z-buffer, ***the compressed z-buffer comprising a plurality of z-records, each z-record embodying z information for a plurality of pixels such that condensed depth information for the plurality of pixels is represented by a single z-record***;
>
> in a second pass, within the graphic pipeline, ***performing a two-level z-test on graphic data, wherein a first level of the z-test compares the graphic data of a current primitive with corresponding information in the compressed z-buffer, and wherein a second level of the z-test is performed on a per-pixel basis in a z-test manner, wherein the second level z-test is performed only on pixels within a record of the compressed z-information in which the first level z-test determines that some but not all pixels of a macropixel are visible***, wherein additional graphic data associated with each primitive is passed into the graphics pipeline on the second pass only for primitives that are at least partially visible; and
>
> communicating data associated with pixels of macropixels determined to be visible to a pixel shader for rendering.

Applicants respectfully maintain that *Voorhies* fails to teach the features emphasized above in claim 13. As discussed in depth above, Applicants submit that while *Voorhies* discloses use of a z-pyramid, this is not equivalent to the compressed z-buffer claimed by Applicants. Claim 13 recites the limitation, "the compressed z-buffer comprising a plurality of z-records, each z-record embodying z information for a plurality of pixels." In the **Response to Arguments** section, the Office Action maintains that *Voorhies* discloses a compressed z-buffer. ("*Voorhies teaches z-pyramid data structure is hierarchical z-buffer that is compressed (c. 33, ll. 36-39; c. 55, ll. 66-67), and so is considered to be equivalent to compressed z-buffer*.") Applicants, however, respectfully

disagree and submits that while *Voorhies* teaches of a z-pyramid data structure that is hierarchal in nature, *Voorhies* does not appear to teach that the z-pyramid is compressed and where the z-pyramid comprises a plurality of z-records, where each z-record embodies z information for a plurality of pixels.

Furthermore, *Voorhies* fails to disclose the two-level z-test recited in claim 13. Claim 13 recites the following:

> performing a two-level z-test on graphic data,
> wherein <u>a first level of the z-test</u> compares the graphic data of a current primitive with corresponding information in the compressed z-buffer, and
> wherein <u>a second level of the z-test</u> is performed on a per-pixel basis in a z-test manner, <u>wherein the second level z-test is performed only</u> on pixels within a record of the compressed z-information in which the first level z-test determines that some but not all pixels of a macropixel are visible . . .

In the **Response to Arguments** section, the Examiner states the following: "*Fig. 11 in Voorhies shows flowchart of z-test, and shows z-test (1114) is first performed on one level, and if that level is not the finest level (1118), the z-test process <u>loops back to the beginning and repeats</u> the z-testing process for the next finest level . . .*" (Office Action, page 2). However, Applicants respectfully point out that claim 13 explicitly defines a first level z-test and a second z-test (and the interrelationship between the two tests). *Voorhies* fails to teach this. In fact, the Examiner admits that "the z-test process <u>loops back to the beginning and repeats</u> the z-testing process for the next finest level." That is, the same z-test is performed in an iterative fashion. There is no distinction made between the first level z-test and the second level z-test, as clearly defined in claim 13. In

this regard, *Voorhies* fails to disclose, teach, or suggest performing the two-level z-test on graphic data as recited in claim 13 above.

Notwithstanding, in an effort to further prosecution, Applicants have amended claim 13 to include the following clarifying language: "such that condensed depth information for the plurality of pixels is represented by a single z-record." Applicants respectfully submit that *Voorhies* fails to teach this feature.

Accordingly, Applicants respectfully submit that independent claim 13 patently defines over *Voorhies* for at least the reason that *Voorhies* fails to disclose, teach or suggest the highlighted features in claim 13 above.

<u>Independent Claim 14</u>

Claim 14, as amended, recites (emphasis added):

> 14. A graphics processor comprising:
> first-pass logic configured to deliver to a graphic pipeline, in a first pass, only a limited portion of graphic data for each primitive, wherein each primitive comprises a plurality of pixels, wherein the limited portion of graphic data comprises location-related data;
> ***<u>logic configured to process the limited portion of graphic data for each primitive to create a compressed z-buffer comprising a plurality of z-records, wherein z-information for a macro-block is compressed into each of the plurality of z-records such that condensed depth information for the macro-block is represented by a single z-record</u>***;
> logic configured to determine, for each primitive, whether the primitive has at least one visible pixel;
> second-pass logic configured to deliver to the graphic pipeline, in a second pass, the remaining graphic data associated with each primitive for only those primitives determined to have at least one visible pixel, the second-pass logic further configured to inhibit the delivery of graphic data to the graphic pipeline for primitives not determined to have at least one visible pixel.

Applicants respectfully maintain that *Voorhies* fails to teach the features emphasized above in claim 14. As discussed in depth above, Applicants submit that while *Voorhies* discloses use of a z-pyramid, this is not equivalent to the compressed z-buffer claimed by Applicants. Claim 14 specifically recites, "logic configured to process the limited portion of graphic data for each primitive to create a compressed z-buffer comprising a plurality of z-records, wherein z-information for a macro-block is compressed into each of the plurality of z-records." While *Voorhies* teaches of a z-pyramid data structure that is hierarchal in nature, *Voorhies* does not appear to teach that the z-pyramid is compressed and where the z-pyramid comprises a plurality of z-records, where z-information for a macro-block is compressed into each of the plurality of z-records. In an effort to further prosecution, Applicants have amended claim 14 to include the following clarifying language: "such that condensed depth information for the macro-block is represented by a single z-record." Applicants respectfully submit that *Voorhies* fails to teach this feature.

Accordingly, Applicants respectfully submit that independent claim 14 patently defines over *Voorhies* for at least the reason that *Voorhies* fails to disclose, teach or suggest the highlighted features in claim 14 above.

Dependent Claims 15-20

Applicants submit that dependent claims 15-20 are allowable for at least the reason that these claims depend from an allowable independent claim. *See, e.g., In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988).

Independent Claim 21

Claim 21, amended, recites (emphasis added):

> 21. A graphics processor comprising:
> logic configured to pass and process only a portion of graphic data passed into a graphic pipeline for each of a plurality of primitives, in a first pass within the graphic pipeline to determine whether the primitive has at least one visible pixel, wherein each primitive comprises a plurality of pixels, and wherein the limited portion of graphic data comprises location-related data;
> ***logic configured to build a compressed z-buffer from processing of the graphic data in the first pass, the z-buffer comprising a plurality of z-records, wherein z-information for a macro-block is compressed into a single record such that condensed depth information for the macro-block is represented by a single record***; and
> logic configured to render, in a second pass within the graphic pipeline, only the primitives determined in the first pass to have at least one visible pixel, wherein the remaining portion of graphic data associated with each primitive is passed into the graphics pipeline on the second pass.

Applicants submit that *Voorhies* fails to teach the compressed z-buffer disclosed in claim 21. As discussed above, while *Voorhies* teaches of utilizing z-buffer tiling hierarchically using a z-pyramid, Applicants submit that this is not equivalent to the z-buffer recited in claim 21. Notwithstanding, in an effort to further prosecution, Applicants have amended claim 21 to include the following clarifying language: "such that condensed depth information for the macro-block is represented by a single record." Applicants respectfully submit that *Voorhies* fails to teach this feature.

Accordingly, Applicants respectfully submit that independent claim 14 patently defines over *Voorhies* for at least the reason that *Voorhies* fails to disclose, teach or suggest the highlighted features in claim 14 above.

Dependent Claims 22-23 and 25-27

Applicants submit that dependent claims 22-23 and 25-27 are allowable for at least the reason that these claims depend from an allowable independent claim. *See, e.g., In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). New dependent claim 27 is added and defines novel and non-obvious features of embodiments of the invention.

CONCLUSION

Applicants respectfully submit that all pending claims are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephone conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

A credit card authorization is provided to cover the fee associated with the accompanying RCE application. No additional fee is believed to be due in connection with this submission. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,

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